

Creatinine Measurement

NKDEP Manufacturer's Workshop

AACC 2004

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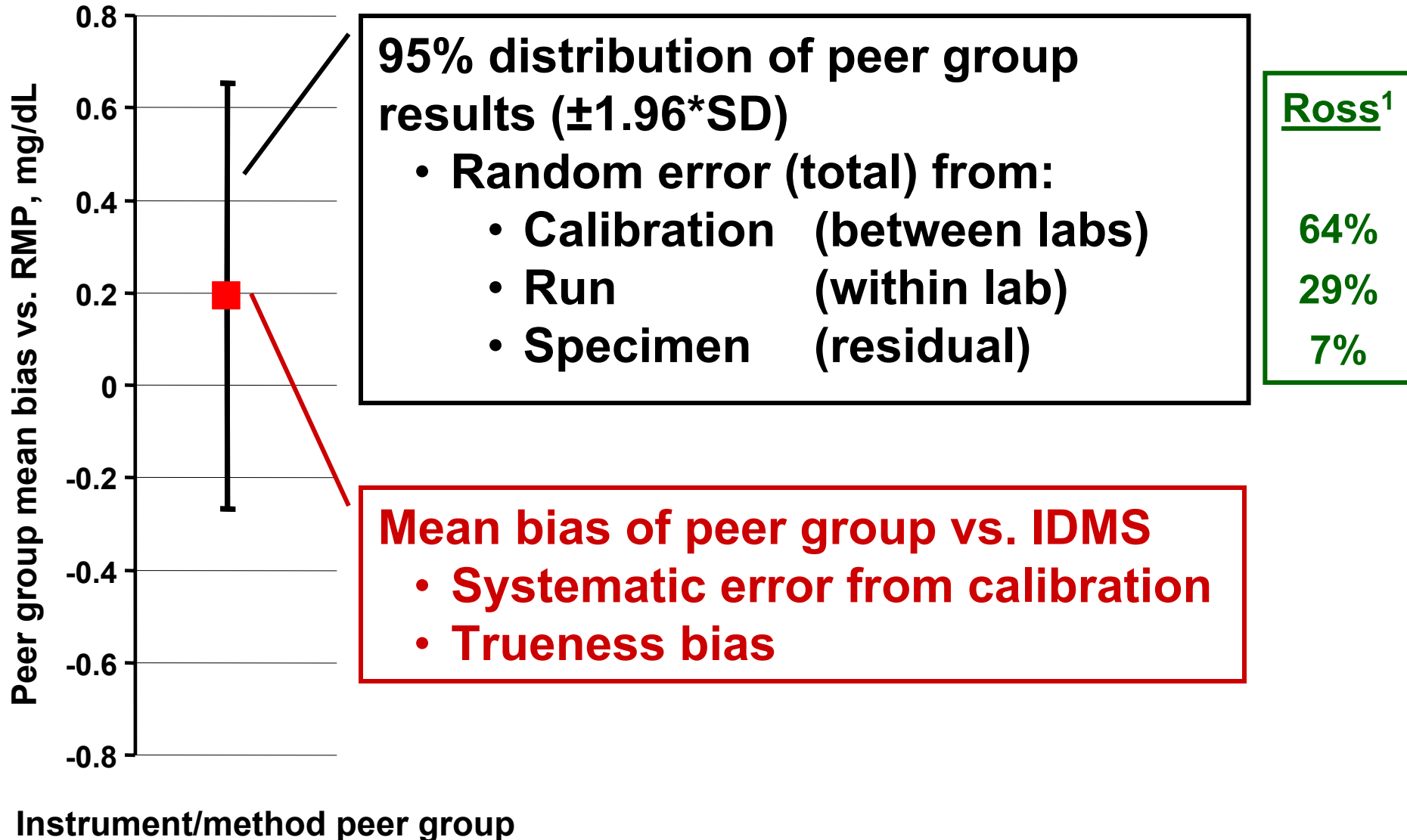
Virginia Commonwealth University

Richmond, VA

Creatinine routine method performance

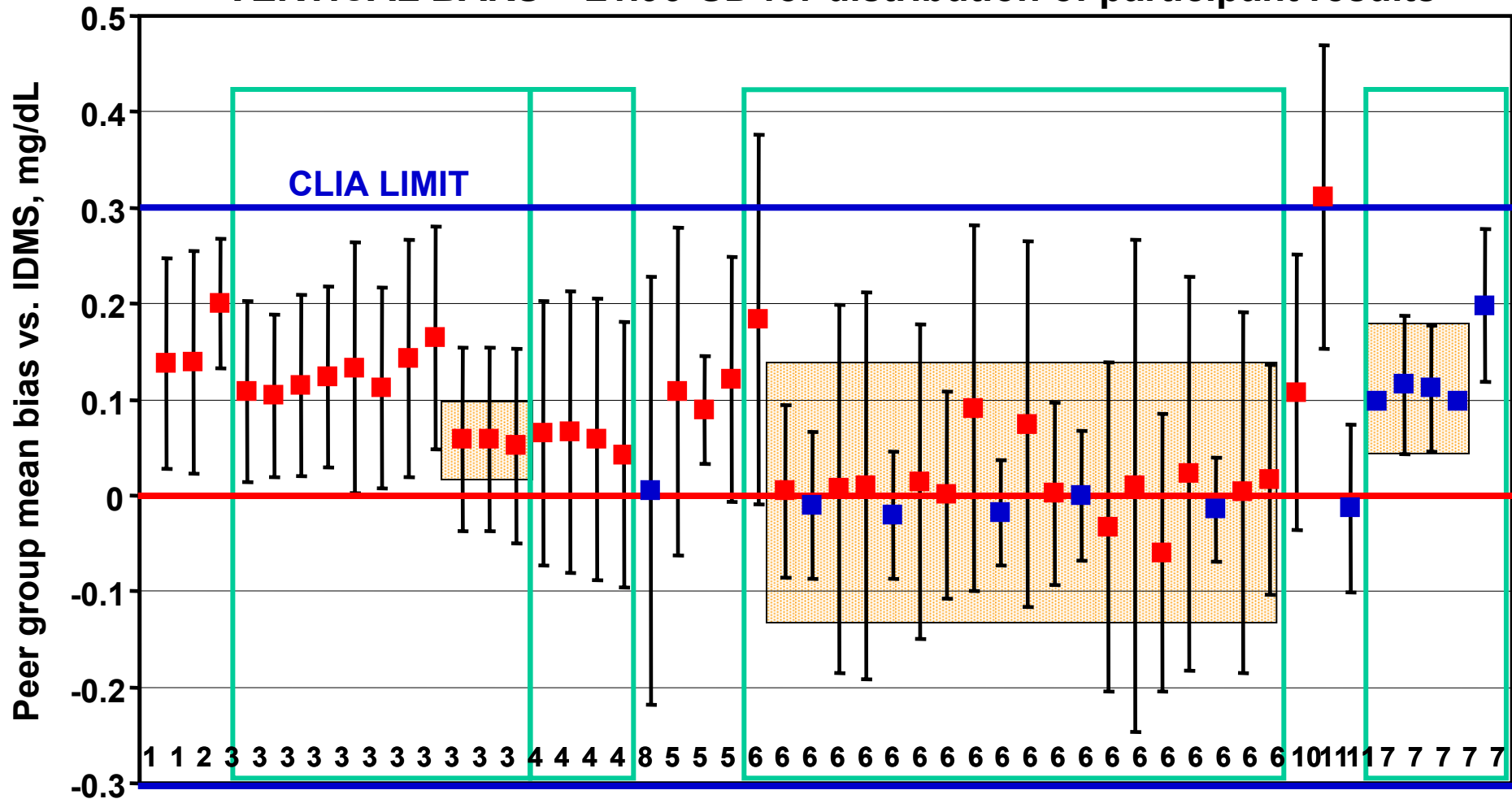
- **CAP Chemistry Survey, October 2003**
 - **Fresh frozen serum specimen**
- **EU International Measurement Evaluation Programme (IMEP-17) 2002**
 - **Fresh frozen serum specimen**
- **Bio-Rad individual laboratory QC data for 2002**

CAP FFS specimen, data presentation



Creatinine = 0.90 mg/dL (79.7 mmol/L)

VERTICAL BARS = $\pm 1.96 \times \text{SD}$ for distribution of participant results



■ Alk Picrate
■ Enzymatic

Instrument/method peer group (10 to 1396 laboratories each)

Miller et al. Arch Pathol Lab Med 2004;accepted

IMEP-17, 2002, Fresh Frozen Serum, N = 833

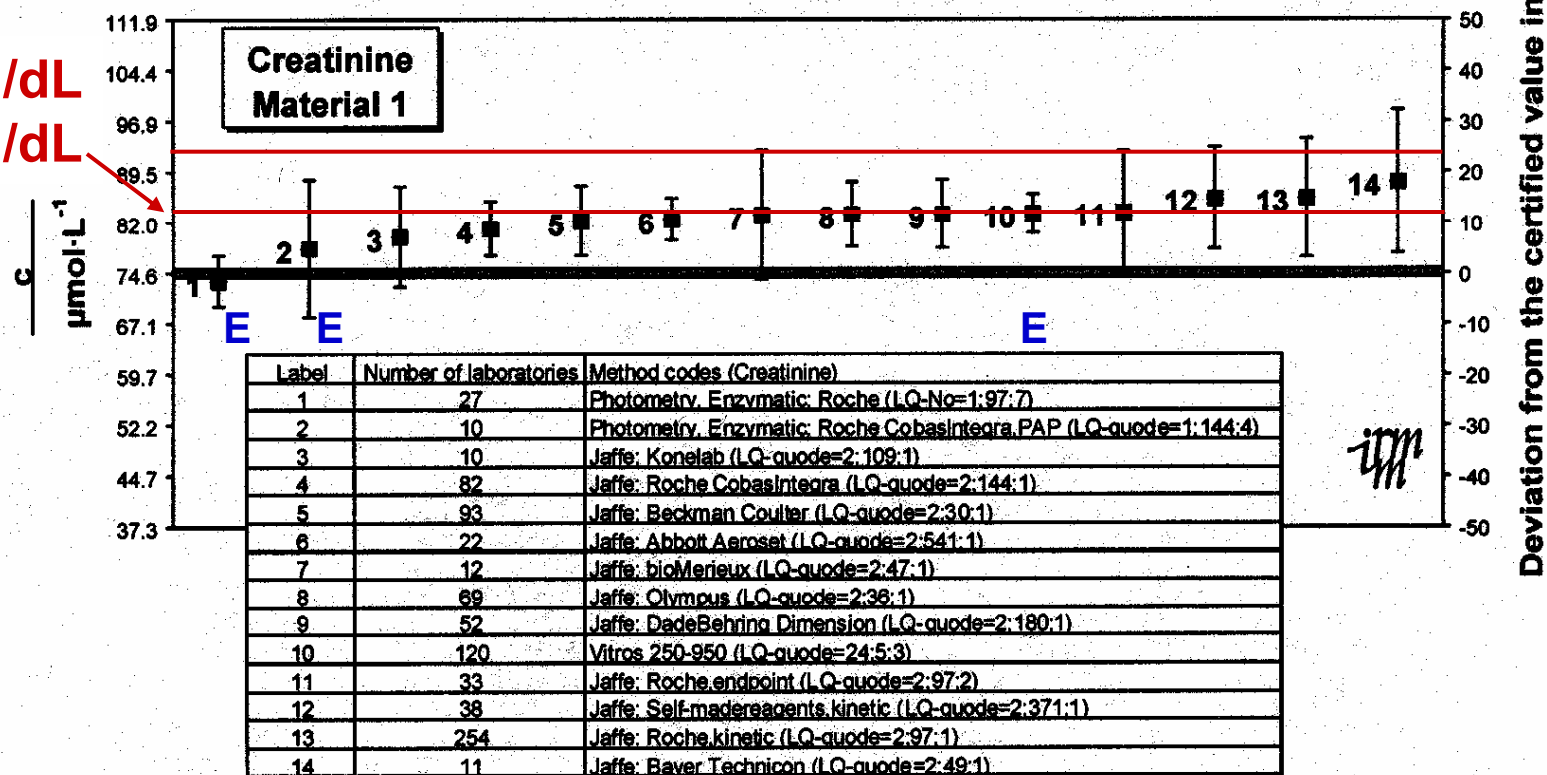
Creatinine = 0.84 mg/dL (74.6 mmol/L)

VERTICAL BARS = ± 1 SD for distribution of participant results

IMEP- 17: Trace and minor constituents in human serum

Certified value : $74.57 \pm 0.57 \mu\text{mol}\cdot\text{L}^{-1}$ [$U=k\cdot u_c$ ($k=2$)]

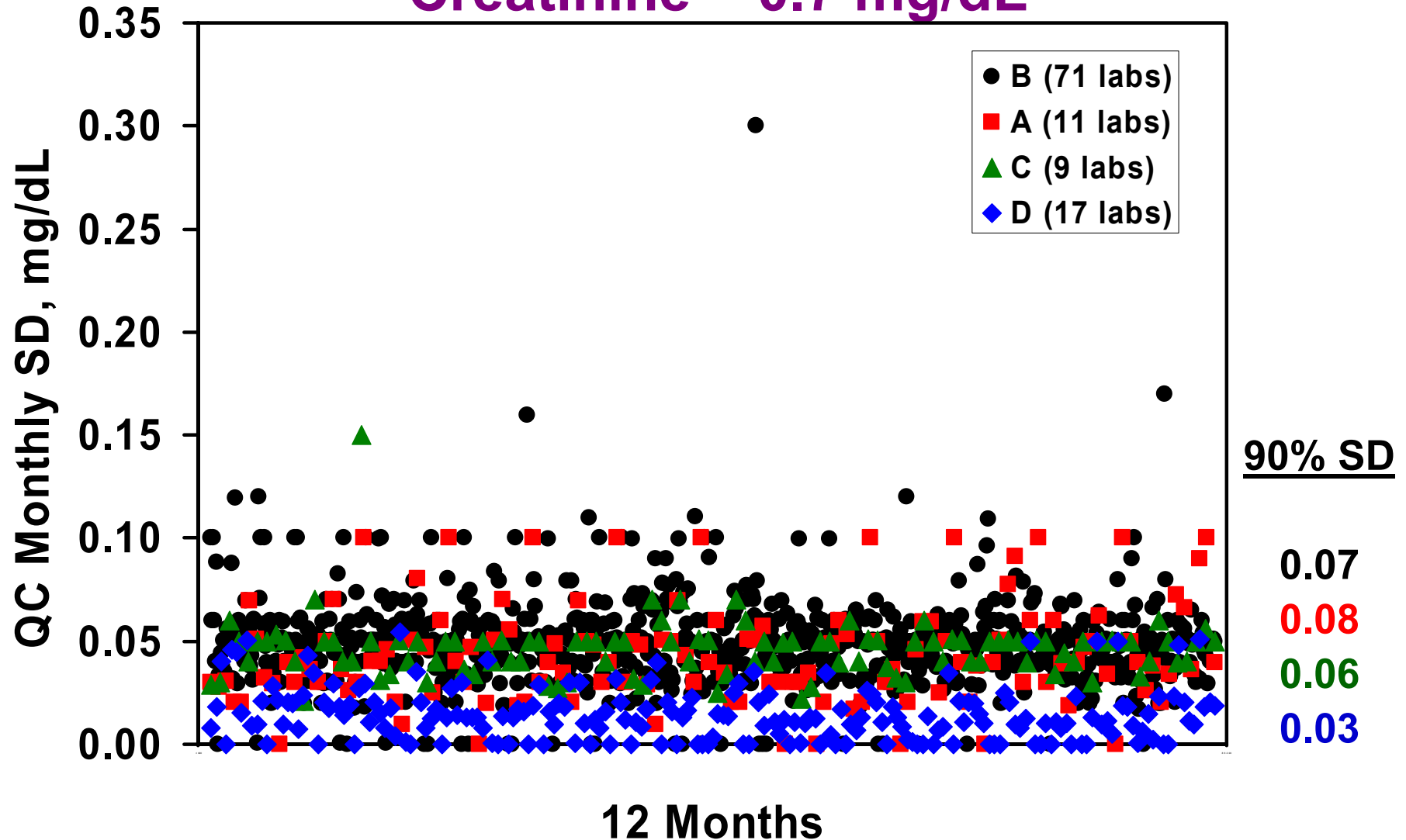
0.2 mg/dL
0.1 mg/dL



The averages of all results (based on all replicates measured) for each method when applied by more than 10 laboratories

Bio-Rad inter-lab QC comparison (within-lab monthly SD for a single lot QC)*

Creatinine ~ 0.7 mg/dL

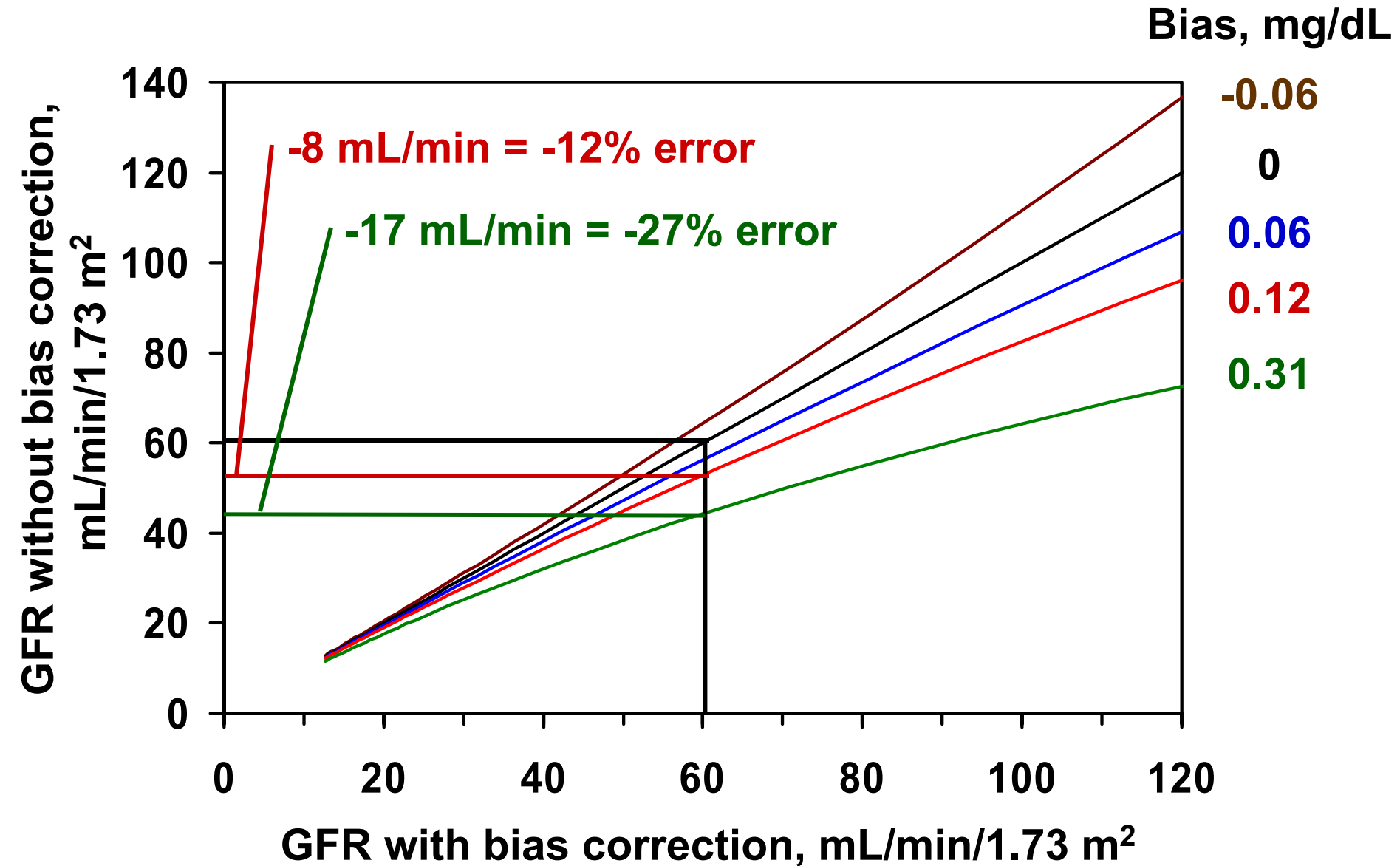


* Bio-Rad Laboratories, Inc. Liquid Multiqual, 2002

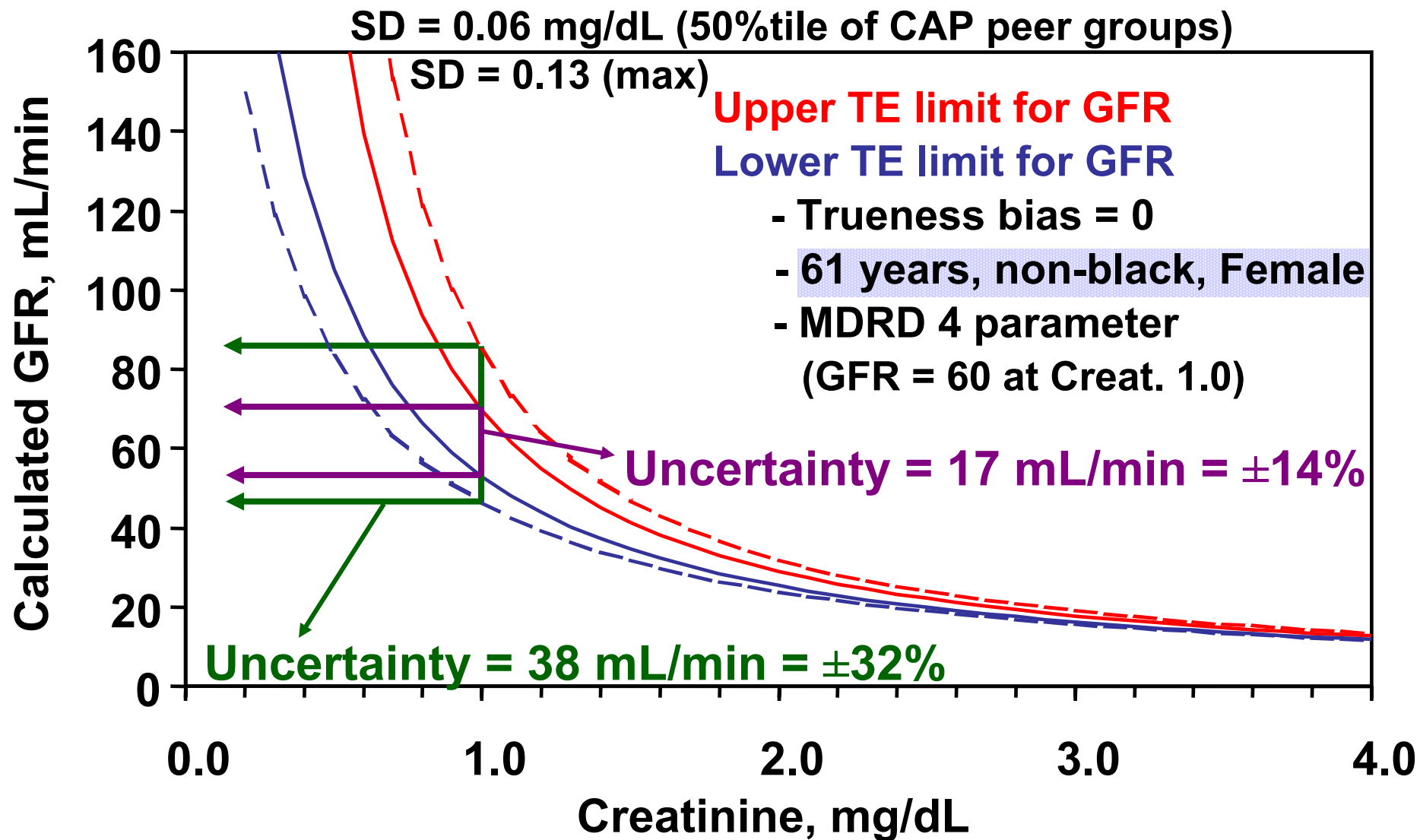
How does current performance impact calculated GFR

- **Four parameter MDRD equation**
- **Critical serum creatinine**
 - ▶ **Adults:**
 - **1.0-1.6 mg/dL (88.4-141 $\mu\text{mol/L}$)**
@ GFR = 60 mL/min/1.73m² for different demographic groups
 - ▶ **Pediatrics: lower values challenging**

Impact of creatinine bias on GFR



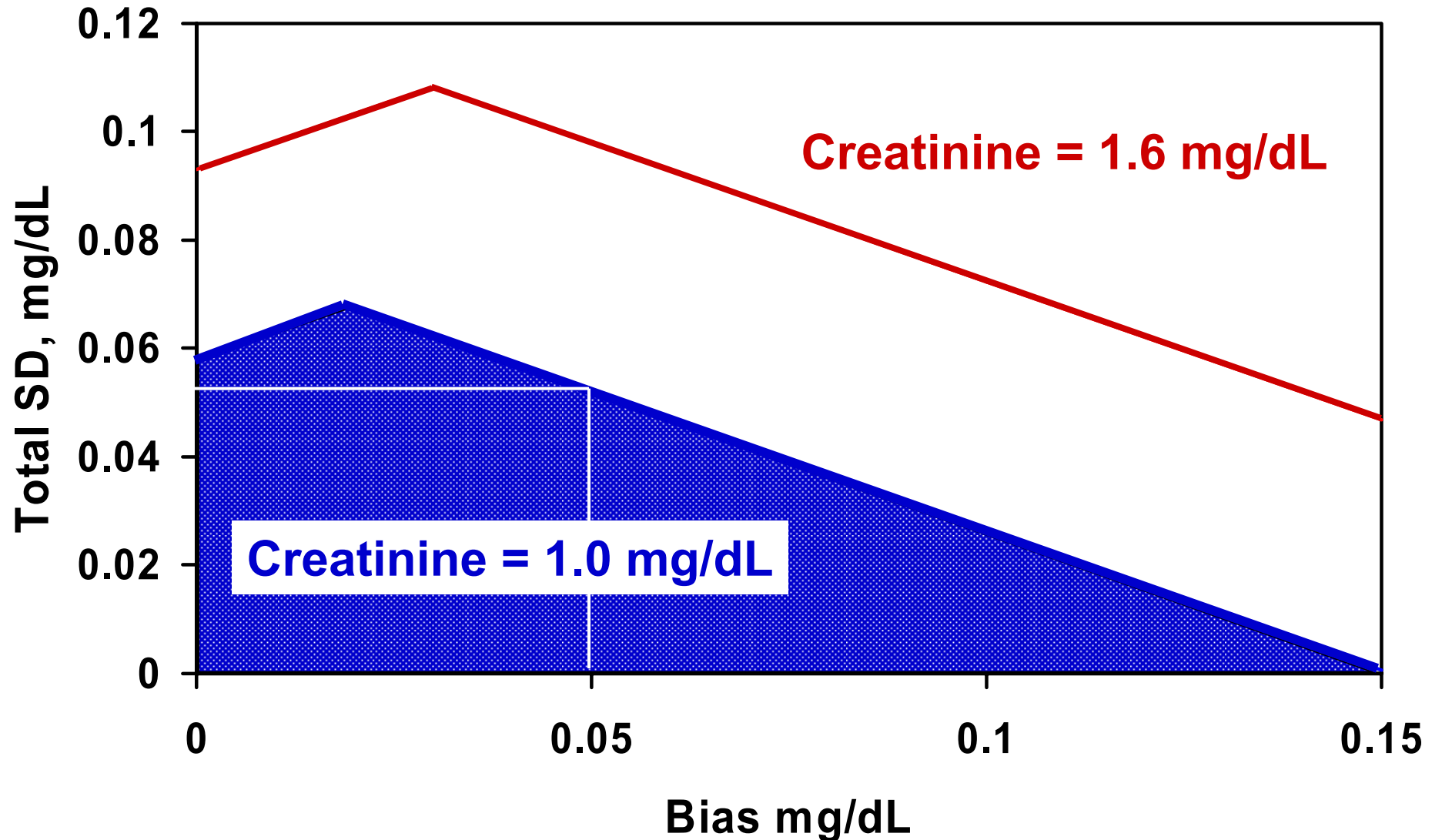
Impact of method variability on GFR



What creatinine performance is needed

- **Clinical goal = total error in GFR of $\pm 30\%$**
 - **MDRD equation coefficients contribute $\pm 15\%$**
- **Measurement contribution to GFR**
maximum TE $\pm 15\%$ at 60 mL/min/1.73m²
 - **Error budget for bias vs. total SD at critical creatinine (1.0 mg/dL; 88.4 μ mol/L)**
 - **PLUS method non-specificity**

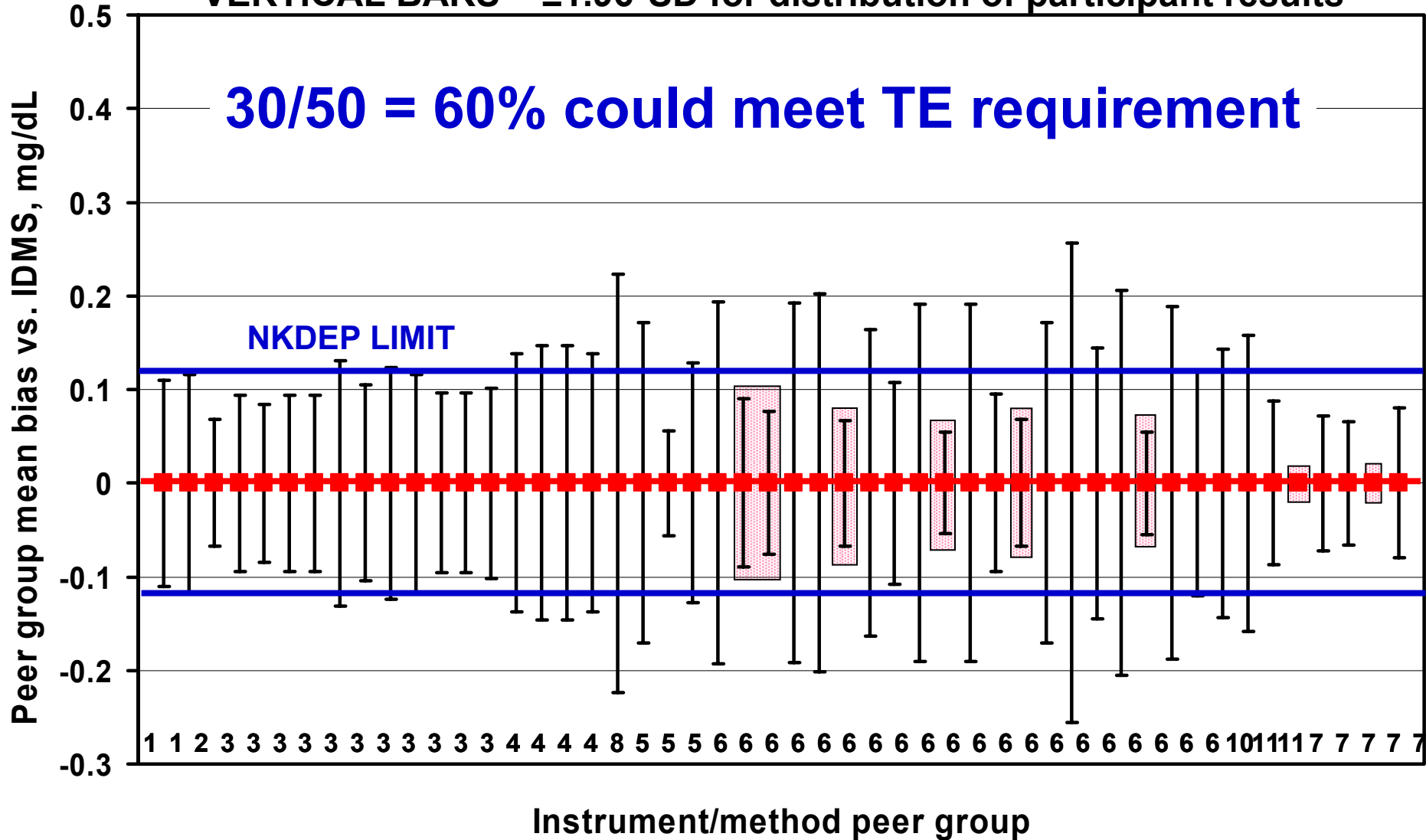
Creatinine error budget for GFR total error = 15% at 60 mL/min/1.73m²



CAP Survey variability IF BIAS = 0
Creatinine = 0.90 mg/dL

VERTICAL BARS = $\pm 1.96 \times \text{SD}$ for distribution of participant results

30/50 = 60% could meet TE requirement



Creatinine method non-specificity

- **Alkaline Picrate**
 - **Keto acids**
 - **Glucose and other metabolites**
 - **Proteins**
 - **Drugs**
- **Enzymatic**
 - **Drugs (fewer)**

Summary: Creatinine Measurement (Adults)

- **Total error goal = $\pm 15\%$ in GFR_{MDRD}**
- **Current bias and variability are too large for clinical requirement**
- **Reduce bias by making calibration traceable to IDMS**
 - **Standardize MDRD coefficients for zero bias**
- **Reduce variability**
- **Non-specificity is a limitation**